

WHAT IS CLAIMED IS:

1. A system for controlling a valve timing in an internal combustion engine, comprising:

a driving rotator rotated by a crankshaft of the engine;

5 a driven rotator provided to a camshaft of the engine, the driven rotator having the driving rotator mounted to produce relative rotation;

a first device which changes a mounting angle between the driving rotator and the driven rotator through relative rotation thereof, the first device comprising first and second rotating mechanisms coupled to each other in series, each rotating mechanism
10 having a rotation range restricted at a predetermined angle; and

a second device which locks the first device at a mounting-angle position suitable for engine start, the mounting-angle position being set between a most-lagged-angle position and a most-advanced-angle position, the second device comprising a first lock mechanism which locks the first rotating mechanism at one of
15 the most-lagged-angle position and the most-advanced-angle position and a second lock mechanism which locks the second rotating mechanism at another of the most-lagged-angle position and the most-advanced-angle position,

the first and second rotating mechanisms being locked by the first and second lock mechanisms at opposite positions to maintain the mounting angle at the
20 mounting-angle position suitable for engine start.

2. The system as claimed in claim 1, wherein one of the first and second rotating mechanisms is driven by a hydraulic pressure, and another is driven by an alternate torque of the camshaft, wherein the one rotating mechanism is returned to a lock position
25 by the alternate torque before engine stop.

3. The system as claimed in claim 1, wherein one of the first and second rotating mechanisms comprises a third lock mechanism which locks the one rotating mechanism at a rotation restricting end on the opposite side of a lock position of the lock mechanism

of the one rotating mechanism, wherein release operation of the two lock mechanisms of the one rotating mechanisms is switched selectively.

4. The system as claimed in claim 1, wherein the first and second rotating mechanisms are controlled by a hydraulic pressure in accordance with an engine speed, wherein when the hydraulic pressure is more than a set value, lock of the two rotating mechanisms is released.

5. The system as claimed in claim 3, wherein the third lock mechanism is controlled by a hydraulic pressure in accordance with an engine speed, wherein the hydraulic pressure is less than a set value, lock of the third rotating mechanism is released.

6. The system as claimed in claim 1, wherein one of the first and second rotating mechanisms is controlled in rotation angle continuously variably, and another is controlled in rotation angle to be switched between the most-lagged-angle position and the most-advanced-angle position.

7. The system as claimed in claim 3, wherein the second and third lock mechanisms each comprise a lock pin provided to one of rotating members of the rotating mechanism in a protrudable and withdrawable way, a lock opening formed in another rotating member and in which the lock pin is engaged when the rotating members produce relative rotation to one rotation restricting end, a spring for biasing the lock pin in a protruding direction, and means for opening and closing the lock opening.

8. The system as claimed in claim 1, wherein the first lock mechanism comprises a lock pin provided to one of rotating members of the rotating mechanism in a protrudable and withdrawable way, and a lock opening formed in another rotating member and in which the lock pin is engaged when the rotating members produce relative rotation to

one rotation restricting end, wherein the lock pin is biased by a spring in a protruding direction, and is moved in a withdrawing direction under a hydraulic pressure in accordance with an engine speed.

5 9. The system as claimed in claim 7, wherein the opening and closing means comprise an operation pin arranged in the lock opening in a protrudable and withdrawable way.

10 10. The system as claimed in claim 7, wherein the lock pin and the lock opening are formed with tapers, the tapers being engaged with each other by protrusion of the lock pin.

15 11. The system as claimed in claim 7, wherein the lock opening is formed with a taper face, the taper face producing a wedge action for guiding a tip of the lock pin to the rotation restricting end when the tip is pressed against the taper face.

12. The system as claimed in claim 9, wherein the operation pin is actuated by a hydraulic pressure.

20 13. The system as claimed in claim 9, wherein the operation pin is restricted in maximum protrusion to have an end face substantially at the same level as an edge of the lock opening.

25 14. The system as claimed in claim 9, wherein the operation pin has an end formed with a curved surface.

15. The system as claimed in claim 12, wherein one of the second and third lock mechanisms comprises a spring for biasing the operation pin in a withdrawing direction, and another comprises a spring for biasing the operation pin in a protruding direction,

wherein each operation pin undergoes the hydraulic pressure against the spring.

16. The system as claimed in claim 1, wherein the camshaft is provided to the intake side of the engine, wherein during cranking, one of the first and second rotating mechanisms is locked at the most-lagged-angle position, and another is locked at a position displaced to the side of the most-advanced-angle position in the rotation range narrower than a maximum rotation range of the one rotating mechanism.

17. The system as claimed in claim 16, wherein one of the first and second rotating mechanisms is driven by a hydraulic pressure, and another is driven by an alternate torque of the camshaft, wherein the one rotating mechanism is returned to a lock position by the alternate torque before engine stop.

18. The system as claimed in claim 1, wherein the camshaft is provided to the exhaust side of the engine, wherein one of the first and second rotating mechanisms is locked at the most-advance-angle position, and another is locked at a position displaced to the side of the most-lagged-angle position in the rotation range narrower than a maximum rotation range of the one rotating mechanism.

19. The system as claimed in claim 18, wherein one of the first and second rotating mechanisms is driven by a hydraulic pressure, and another is driven by an alternate torque of the camshaft, wherein the one rotating mechanism is returned to a lock position by the alternate torque before engine stop.

20. A system for controlling a valve timing in an internal combustion engine, comprising:

a driving rotator rotated by a crankshaft of the engine;

a driven rotator provided to a camshaft of the engine, the driven rotator having the driving rotator mounted to produce relative rotation;

first means for changing a mounting angle between the driving rotator and the driven rotator through relative rotation thereof, the first means comprising first and second rotating mechanisms coupled to each other in series, each rotating mechanism having a rotation range restricted at a predetermined angle; and

5 second means for locking the first means at a mounting-angle position suitable for engine start, the mounting-angle position being set between a most-lagged-angle position and a most-advanced-angle position, the second means comprising a first lock mechanism which locks the first rotating mechanism at one of the most-lagged-angle position and the most-advanced-angle position and a second lock mechanism which
10 locks the second rotating mechanism at another of the most-lagged-angle position and the most-advanced-angle position,

the first and second rotating mechanisms being locked by the first and second lock mechanisms at opposite positions to maintain the mounting angle at the mounting-angle position suitable for engine start.

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